

Note-taker: Multiplication Properties of Exponents (Part 1)

A monomial is a number, a variable, or a product of a number and one or more variables.

- An expression involving the division of variables is not a monomial.
- Monomials that are real numbers are called constants.
- Expressions involving the multiplication of a number and variable(s) are called linear expressions.

Example 1: Identify Monomials

Determine whether each expression is a monomial. Explain your reasoning.

	Expression	Monomial?	Reason
1.	-5	yes	constant term
2.	$p + q$	no	not a product
3.	x	yes	variable term
4.	$\frac{c}{d}$	no	Division - variable in the denominator
5.	$\frac{abc^8}{5}$	yes	There are no variables in the denominator.

$\frac{1}{5} abc^8$

base

a^2

exponent

2^3

Example 2: Product of Powers Property

Simplify. Write your answers as a power.

Together	Try These on Your Own
1. $5^3 \cdot 5^6 = 5^9$	5. $4^5 \cdot 4^3$
2. $x^2 \cdot x^3 \cdot x^4 = x^9$	6. $y^3 \cdot y^4 \cdot y^5$
3. $3^1 \cdot 3^5 = 3^6$	7. $2 \cdot 2^6$
4. $(-2)^1(-2)^4 = (-2)^5$	8. $(-5)(-5)^3$

Product of a Power

To multiply powers that have the same base, add the exponents.

$$a^2 = a \cdot a$$

Together	Try These on Your Own
9. $2x^4 \cdot 8x^2 = 2 \cdot 8 \cdot x^4 \cdot x^2 = 16x^6$	13. $8y^9 \cdot 9y^2 =$
10. $5x^7 \cdot x^6 = 5x^{13}$	14. $y^3 \cdot 4y^3 =$
11. $(4xy^5)(-7x^2y^3) = 4 \cdot -7 \cdot x^1 \cdot x^2 \cdot y^5 \cdot y^3$ $= -28x^3y^8$	15. $(-3x^8y^2)(-8xy^7) =$
12. $(2a^4)(2a^3b^2)(-3ab^3)$ $2 \cdot 2 \cdot -3 \cdot a^4 \cdot a^3 \cdot a^1 \cdot b^2 \cdot b^3$ $= -12a^8b^5$	16. $(-5x^2)(3x^4y^2)(2xy^6)$

Example 3:

Power of a Power Property

Simplify. Write your answers as a power.

Together	Try These on Your Own
1. $(3^5)^2 = 3^5 \cdot 3^5 = 3^{10}$	5. $(5^2)^3 = 5^6$
2. $(y^2)^4 = y^2 \cdot y^2 \cdot y^2 \cdot y^2 = y^8$	6. $(x^3)^2 = x^6$
3. $[(-3)^3]^2 = (-3)^3 \cdot (-3)^3 = (-3)^6$	7. $[(-2)^3]^4 = (-2)^{12}$
4. $[(a+1)^2]^5 = (a+1)^2 \cdot (a+1)^2 \cdot (a+1)^2 \cdot (a+1)^2 \cdot (a+1)^2$ $= (a+1)^{10}$	8. $[(a-2)^3]^2 = (a-2)^6$

Power of a Power

To find the power of a power, multiply the exponents.

Try These:

1. $(a^3)^5 = a^{15}$ 2. $(4^2)^2 = 4^4$ 3. $(b^3)^3 = b^9$ 4. $[(d+3)^4]^3 = (d+3)^{12}$ 5. $(-3^2)^7 = (-3)^{14}$

Example 4:

Special Types of Exponents

Simplify. Write your answers as a power.

Together	Try These on Your Own
1. $(-2)^2 = 2^2 = 4$	4. $(-5)^2 = 5^2 = 25$
2. $-(-2)^2 = -2^2 = -4$	5. $-(-5)^2 = -5^2 = -25$
3. $-(2)^2 = -2^2 = -4$	6. $-(5)^2 = -5^2 = -25$

Note-taker: Multiplication Properties of Exponents (Part 2)

Example 5:

Power of a Product Property

Simplify.

Together	Try These on Your Own
1. $(5x)^2 = 5^2 \cdot x^2 = 25x^2$	5. $(3y)^3 =$
2. $(4yz)^3 = 4^3 \cdot y^3 z^3 = 64y^3 z^3$	6. $(3xy)^4 =$
3. $(-2w)^2 = (-2)^2 \cdot w^2 = 4w^2$	7. $(-3y)^2 =$
* 4. $-(2w)^2 = -(2)^2 \cdot w^2 = -4w^2$	8. $-(3y)^2 =$

Power of a Product

To find the power of a product, find the power of each factor and multiply.

Together	Try These on Your Own
9. $(3x^4)^3 = 3^3 \cdot x^{12} = 27x^{12}$	13. $(9a^2)^5 =$
10. $(6ab^2)^3 = 6^3 \cdot a^3 b^6 = 216a^3 b^6$	14. $(5a^3b)^4 =$
11. $(-7x^2y^3)^2 = (-7)^2 \cdot x^4 y^6 = 49x^4 y^6$	15. $(-3x^8y^2)^4 =$
12. $(-3ab^3)^3 = (-3)^3 \cdot a^3 b^9 = -27a^3 b^9$	16. $(-5x^2y^5)^3 =$

Example 6:

Simplify completely.

Using All Three Properties

Together	Try These on Your Own
1. $(4x^2y)^3 \cdot x^5 =$ $(4)^3 \cdot x^6 \cdot y^3 \cdot x^5$ $64 \cdot x^6 \cdot x^5 \cdot y^3 = 64x^{11}y^3$	4. $(3x^4y)^2 \cdot y^5 =$ $(-1m^2t^3)^2$
2. $(3xy^4)^2(-y^2)^3 =$ $(3)^2 \cdot x^2 \cdot y^8 \cdot (-1)^3 \cdot y^6$ $9x^2 \cdot y^8 \cdot -1 \cdot y^6$ $9 \cdot -1 \cdot x^2 \cdot y^8 \cdot y^6$ $-9x^2y^{14}$	5. $(x^3y)^2[(-5y^3)]^2 =$
3. $(-2x^3y^4)^3(-3xy^3)^2 =$ $(-2)^3 x^9 y^{12} \cdot (-3)^2 x^2 y^6$ $-8x^9 y^{12} \cdot 9 \cdot x^2 \cdot y^6$ $-8 \cdot 9 \cdot x^9 \cdot x^2 \cdot y^{12} \cdot y^6$ $-72x^{11}y^{18}$	6. $(-5x^2y^3)^2(xy^2)^2 =$